

PATENT SPECIFICATION

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(54) METERING PUMPS

(71) We, WILHELM HEDRICH VAK-
UUMANLAGEN GMBH & CO. KG., organ-
ised and existing under the laws of the Fed-
eral Republic of Germany, of D-6331 Kat-
zenfurt, Germany, do hereby declare the
invention, for which we pray that a patent
may be granted to us, and the method by
which it is to be performed to be particularly
described in and by the following state-
ment:-

This invention relates to apparatus for
measuring or supplying measured quantities
of fluids in the form of liquid or highly visc-
ous media, all of which are included in the
general term "liquids" used in the following
description and claims.

Where a number of liquid components,
some of which may be more viscous than
others, are to be mixed together, they must
generally be brought to a uniform consis-
tency before they are admixed. To produce
the finished product correct proportions,
which may be stoichiometric, of these indi-
vidual components must be mixed together.
The required quantities of these liquids,
which have to be accurately controlled, have
hitherto generally been conveyed into mix-
ing chambers by means of metering pumps,
which are arranged either in conduits con-
necting the containers or actually in a stirring
or mixing chamber. These two arrangements
suffer, however, from the disadvantages that,
on the one hand, it is only possible to main-
tain the required uniform temperatures over
long conduits at a considerable expense
while, on the other hand, the use of such long
conduits means that the materials take an
unnecessarily long time to pass through
them, which is undesirable, especially when
the setting time or pot life of the materials is
important.

If the pump is arranged within the mixing
chamber it is operated by a driving shaft,
which is usually driven from the cover side of
the container simply through the interior of

the container. In the case of the last-
mentioned proposals, the driving shafts
become encrusted, as do the valve seats, so
that the quantities discharged are not
uniform. There is also the related disadvan-
tage that the discharge times, more particu-
larly for materials which are highly viscous
and are under a vacuum, have been consid-
erably prolonged.

An attempt has been made to overcome
these disadvantages by using a two-part con-
tainer, the lower part of which is moved axi-
ally relatively to the upper part, and has,
arranged in it and connected to an agitating
device, a kind of needle valve against which
the lower part of the container is pressed by
raising it. With this arrangement, however,
the quantity of material to be ejected
depends entirely on the viscosity of the mat-
erial remaining absolutely uniform while its
rate of flow continually varies when the valve
is opened, that is to say when the lower part
of the container is lowered.

The possibility of conveying both liquid
and highly viscous compositions in uniform
quantities, in each case at equal intervals of
time even under a vacuum from one con-
tainer into a nearby container and of ejecting
it quickly from the latter in equal quantities,
could not be achieved with this arrangement.

The present invention has as amongst its
objects to obviate or reduce the aforesaid
disadvantages by the provision of apparatus
which can be driven from the outside, which
is suitable for both very liquid and highly
viscous materials and, more particularly,
which can also be adjusted in an infinitely
variable manner to suit the material to be
dealt with, and which can be under a vacuum.
It has been found possible, without having to
convert existing installations, to obtain
immediate and precise metering, and there-
fore higher and better production, especially
for high-quality mass-produced articles.

This object can be achieved by using a

pump for delivering and/or metering liquids
 comprising a pumping cylinder the tempera-
 ture of which can be controlled and which is
 formed with sections of different diameters,
 5 and a pumping and/or metering piston opera-
 ting in the cylinder, wherein the cylinder is
 provided with an inlet passage at its end
 opening into the section of larger diameter,
 means for securing this end of the cylinder to
 10 a container supplying the liquid, the pumping
 piston being reciprocable in the smaller
 diameter section of the cylinder, a valve
 member carried by the pumping piston and
 projecting from it for reciprocating engage-
 15 ment in the inlet passage, an outlet for the
 liquid leading from the larger diameter sec-
 tion of the cylinder, a non-return valve in the
 outlet, a piston rod connected to the pump-
 ing piston and projecting from the cylinder
 20 and adjustable abutments for limiting the
 travel of the pumping piston.

According to one arrangement the valve
 member is in the form of a piston which is
 fixed to the pumping piston and which closes
 25 the inlet passage when it enters the inner end
 of the latter.

The piston may be hollow with a port
 opening into the cylinder and contains a
 spring-loaded buffer piston movement of
 30 which against the spring force absorbs surges
 of pressure at the times of closing of the inlet
 passage.

Metering is effected by the suction travel
 of the valve piston along the inlet passage,
 35 which acts as a valve seat, into the metering
 chamber, while when it leaves the valve seat
 there is an increase in the internal cross-
 section and in the suction force due to the
 substantially larger diameter of the pumping
 40 and metering section of the cylinder, so that
 the metering chamber is quickly filled.
 Reversing the direction of travel of the piston
 brings about the closing of the inlet valve and
 the discharge of the liquid composition or
 45 material, which had hitherto been kept in the
 metering chamber by the outlet valve, to the
 next processing, filling or mixing station.

According to another arrangement the
 valve member operates and contains a non-
 50 return valve allowing the passage of liquid
 from the inlet passage to the cylinder.

The provision of the valve piston with such
 a non-return valve, which closes in the direc-
 tion of the dispensing container, is used
 55 advantageously when the valve piston does
 not leave the inlet passage or in other words
 the valve seat. In such a case it is possible, for
 example, to process a material which might,
 because of a too-great inlet pressure, flood
 60 the metering chamber by way of the non-
 return valve, before the valve piston has left
 its seat.

An extension of the use of the invention is
 possible by providing a buffer piston in the
 65 valve piston. This advantageously achieves

the result that the high speed of flow which
 occurs as the valve piston approaches the
 inlet passage up to the moment of closing is
 substantially reduced in the narrow section
 70 part of the cylinder since the displaced liquid
 is received in the valve piston.

A further advantageous feature of the
 invention is to make the cylinder of double-
 wall construction and to surround it with
 heating and/or cooling means controlled by
 75 temperature sensing elements.

The pumping and/or metering piston is
 also surrounded in the region of its guided
 length with sealing elements or rings, more
 particularly ones made of a barrier material.
 80 Also the axial movement of the piston
 assembly is capable of being limited by
 adjustable abutments or stops, preferably in
 the region of the driving member which
 operates the pump. 85

The advantages which are obtained with
 the present invention consist primarily in
 that, instead of having moving and pumping
 elements for the outlet valves arranged
 within the mixing vessels or reaction con-
 90 tainers which require a complicated sealing
 arrangement for outwardly extending driv-
 ing shafts to operate them, more particularly
 for vacuum vessels, the drive elements can be
 located outside the pumping chamber. 95
 Furthermore the metering pumps, which
 were previously also arranged within the
 chamber and were difficult to control and
 which were also driven from outside, are now
 replaced by the pumping and metering 100
 apparatus according to the present invention
 and, at the same time, there is no need for
 special inlet or outlet valves, these being
 replaced by the proposed valve piston. A
 further advantage is the simple assembly of 105
 the pumping and metering apparatus, which
 can be fitted without any great outlay, simply
 by the provision of a flange or other mount-
 ing means and an inlet passage which will
 connect with the outlet bore which is usually 110
 present on vessels containing liquid or highly
 viscous materials for the purpose of dispens-
 ing exact portions of the contents thereof.

Constructional examples of the invention
 are shown diagrammatically in the accom- 115
 panying drawings, in which:-

Fig. 1 shows a part-sectional view of a
 pump for delivering and/or metering liquids,
 which pump includes a valve seat, a valve
 piston, a metering chamber and a pumping 120
 piston;

Fig. 2 is a part section through the cylinder
 and piston of a pump which is similar to that
 shown in Figure 1 but which has a non-return
 valve with its seat arranged in the pumping 125
 piston;

Fig. 3 is a part section through a pump
 which is similar to that shown in Fig. 1 except
 that the valve piston has a buffer piston
 arranged in it, in place of the non-return 130

valve of Fig. 2.

Referring to Fig. 1, this shows a pump having a cylinder, indicated generally at 1, which is provided at one end with a flange 2 by which it can be connected to a container of any desired shape containing the liquid to be pumped and metered without requiring the provision of a special supply conduit for delivering the liquid within the container to the pump, by which it is then delivered to a further processing or treatment station. The transfer of the liquid from the container to the metering chamber 5 of the pump shown in Fig. 1 is effected by suction when a valve piston member 10 provided on the end of the pumping piston 9 leaves the lower end of its valve seat, which is of hollow cylindrical form as shown at 3 and is provided by the inlet passage 4 of the pump. When the valve piston 10 leaves its seat 3 during downward travel of the piston 9 liquid from the container quickly fills the chamber 5 as a result of the vacuum produced by the travel of the piston 9.

This arrangement is particularly advantageous for delivering liquids from vacuum vessels where there is only a small difference in level at the inlet. The suction effect is, however, also of importance for very viscous liquids, since it is possible during the suction stroke to overcome easily the frictional resistance which is present with such viscous liquids and tends to increase the resistance to flow in the inlets to pumps. Thus the apparatus of the invention is particularly suitable for delivering and/or metering components of casting resins which are prepared under reduced pressure and which have to be discharged as quickly as possible because they have only short pot lives before they begin to set. The invention reduces the risk of passages becoming blocked, as has often happened in the past.

The apparatus of the invention is also suitable for use with compositions, such as highly viscous casting resin components which are enriched with fillers, such as quartz powder, asbestos or the like, and which are liable to form sediments even in the mixing chamber. Any such accumulations in the apparatus of the invention, which would generally collect near the outlet passage 6 from the mixing chamber, are ejected during the discharge or pumping period by the pressure produced in the chamber 5 by the piston 9, while parts of it are broken up and returned to the chamber by the valve piston 10. This piston also has the effect of producing a scavenging and cleaning action in the inlet 4.

As shown in Fig. 1 the cylinder 1 is surrounded by a jacket 18 and is provided with one or more heating and/or cooling elements 18a, which are controlled automatically by temperature-responsive means (not shown) to keep the cylinder at the correct tempera-

ture.

In order to obtain precise metering of the quantities to be delivered at each stroke through the passage 6, which is provided with a non-return valve 7, adjustable stops 11 are provided to enable the stroke of the piston 9 to be adjusted so that the amounts delivered at each stroke can be varied as desired from zero to a maximum value. The pumping and metering operation itself begins at the moment when the valve piston 10 closes the inlet 4 and it ends when an abutment 11 limits the upward stroke of the piston.

A modified form of pump is shown in Fig. 2, in which the piston 10, which in this case always operates within the passage 4, is provided with its own non-return ball valve which is spring-biased into a closed position in which it closes an opening 15 formed in the centre of the end face of the piston 10, which piston is also formed with outlet ports 16. This non-return valve allows liquid to flow past it and through the ports 16 into the chamber 5 during downward travel of the piston 9. During upward travel of the piston 9 the aperture 15 is closed so that liquid from the chamber 5 is discharged through the outlet 6. Control of the stroke is by abutments 11 (Fig. 1).

Another modification, which is very useful for some particular purposes, is shown in Fig. 3. In this one the valve piston 10, which operates in the passage 4 in a similar manner to the one shown in Fig. 1, is provided with a buffer piston 17. This buffer piston limits the build up of pressure in the chamber 5 which occurs in the metering chamber 5 as the end of the piston 10 enters the inlet passage 4, which latter provides the valve 3, as was the case with Fig. 1. This is advantageous with some liquids since, in this way, the high speeds of flow which occur during a pressure build-up shortly before the moment of closure, when there is a rapid narrowing of the passage through which the liquid is flowing, are substantially reduced, since excess liquid is received in the piston 10 due to the displacement of the spring-biased piston 17. The main advantage of this construction is found when liquids containing abrasive particles are being used which might damage the walls of the cylinders and pistons. This arrangement can be given a substantially longer life.

WHAT WE CLAIM IS:-

1. A pump for delivering and/or metering liquids comprising a pumping cylinder the temperature of which can be controlled and which is formed with sections of different diameters, and a pumping and/or metering piston operating in the cylinder, wherein the cylinder is provided with an inlet passage at its end opening into the section of larger diameter, means for securing this end of the cylinder to a container supplying the liquid,

the pumping piston being reciprocable in the smaller diameter section of the cylinder, a valve member carried by the pumping piston and projecting from it for reciprocating engagement in the inlet passage, an outlet for the liquid leading from the larger diameter section of the cylinder, a non-return valve in the outlet, a piston rod connected to the pumping piston and projecting from the cylinder and adjustable abutments for limiting the travel of the pumping piston.

2. A pump according to claim 1, wherein the valve member is in the form of a piston which is fixed to the pumping piston and which closes the inlet passage when it enters the inner end of the latter.

3. A pump according to claim 2, wherein the valve piston is hollow with a port opening into the cylinder and contains a spring-loaded buffer piston movement of which against the spring force absorbs surges of pressure at the times of closing of the inlet passage.

4. A pump according to claim 1, wherein the valve member operates and contains a non-return valve allowing the passage of

liquid from the inlet passage to the cylinder.

5. A pump according to claim 4, wherein the valve member operates throughout its stroke as a piston in the inlet passage. 30

6. A pump according to any of the preceding claims, wherein the cylinder has a double wall provided with heating and/or cooling means and with temperature responsive means for controlling the temperature of the cylinder. 35

7. A pump according to any of the preceding claims, wherein the pumping piston is provided with sealing rings which surround the part of it operating in the smallest diameter section of the cylinder. 40

8. A pump according to any of the preceding claims, substantially as herein described with reference to the accompanying drawings. 45

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